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SUCCESSES AND FAILURES WITH OIL SPILLS IN THE SOUTHEASTERN INLAND WATERS

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ABSTRACT

This paper presents a brief review of several spill cases that have occurred in the Southeast in the recent past. Each case describes a unique situation – either in terms of containment, retention or removal methodology.

At Athens, Georgia, a pipeline break caused the closure of the Athens Water Supply System for twenty-four (24) hours. Poor initial retention allowed taste, odors, and some light sheens to pass through the filters at the water plant into the home, causing some sixty-four (64) complaints within a matter of hours. Several inexpensive changes in retention procedures and water treatment techniques returned the situation to normal in a matter of hours.

A pipeline break near Shepherdsville, Kentucky, forced some 16,000 gallons of crude oil into a subsurface layer of gravel. Storage of the oil in this fashion constituted a leaching source for the nearby water course that could have persisted for a year or more. Interception trenches were used to tap the gravel layers and water was forced into the layer up the gradient in order to "flush" the system. Ninety percent recovery was achieved at moderate expense.

A vandalized storage tank adjacent to the Congaree River was emptied of 10,000 gallons of Bunker "C" near Columbia, South Carolina. Elaborate containment and recovery procedures were employed downstream. The oil, however, disappeared – save for minor vegetation stain. Not even a sheen reached the recovery site. River velocity, wind speed, temperature of the water and turbidity are discussed as contributors to this phenomena.

At Jackson, Mississippi, a broken sludge pond dyke at a drilling operation dumped 40,000 gallons of "oil slops" and brine into the Big Black River. Retention on the surface was impossible because of the eight to ten knot river velocity. Light disposable sorbing booms were used to recover an estimated eighty percent of the oil.

At Memphis, Tennessee, a piston film "Herder" was used to aid in recovering a portion of a 100,000 gallon spill. Because of surface debris, wind and river velocity, the Herder forced the oil into difficult tree and brush infested areas. The oil literally "ringed" every obstacle floating – or fixed – in the area. Cleanup costs soared.

Pictures and sketches will be utilized to emphasize technical aspects of each situation.

INTRODUCTION

The newspapers are being literally "stuffed" with sensational coverage of coastal oil spills. Research money continues to pour into equipment and technique development and into "fate and effect of oil in the environment" studies.

Largely, these efforts focus on the coastal spill. According to statistics released in 1972 by the Environmental Protection Agency, 66 percent of the total volume of oil spilled in the United States in 1971 was spilled into Inland Waters. During the year 1971 and through April of 1972, well over one million gallons of various petroleum products were spilled into Inland Waters in the Southeast. EPA, Region IV, spent over three hundred mandays in the field responding to, cleaning up, and investigating these various events for legal enforcement. Efforts to quantitate the environmental damage done by these spills have actually been minor and a matter of observation rather than of long-term field studies and detailed lab processes.

Even with this cursory type information, we have experienced certain environmental damage phenomena that unquestionably represent future long-term damage to a number of streams in this part of the country. We have noted, for example, large cumbersome blooms of algae within the oil-coated reach of the stream.[1] We have observed that the light-cut fractions often disperse within the water column with minimum mechanical manipulation. We have found taste and odors – and sheens – for example, passing through a city's water supply system and into the consumer's home after standard filtration and chemical treatment, even when that city's intake was eight feet beneath the water surface and no vortex was present. We have also been made aware of numerous fish kills, extensive bottom biological damage, and we are currently concerned with the possibility that some of the synthetic biological reactions to

an oil spill – such as an algae bloom -- may stimulate the growth of deadly pathogenic parasites.[2,3,4] But, for the most part, these things are involved with damage. These are things that research will have to answer for us in the future.

But there is still another informational area in which the inland water spill lags considerably behind coastal spills and that is retention, recovery, and disposal methodologies. While demonstrations are taking place throughout the country, displaying new and exotic, expensive and heavy equipment to contain, immobilize, and recover – and even prevent – the coastal spill, we, in the spill response business in inland waters, still observe the era of the hog-wire, bale-of-hay, two-by-four-board-across-the-stream, approach to clean-up.[5] Many people in this business feel that an inland oil spill is a known vector, that its physical parameters are predictable. Wind temperature, river turbidity, direction of the river, velocity of the river, are all known factors to the extent that the travel of the oil, its destination and its recovery potential are one simple neat package. Yet, there are those like the writer who would argue that each inland spill, in its own fashion, presents to those responding to the spill some unique problem.

Accordingly, this paper will expand on five different events occurring in five different states, different topographic features, entirely different river systems – and will present to the audience some unique wrinkle in each which had to be resolved before a reasonable approach to clean-up and protection of the environment could be effected.

Athens, Georgia

In 1971 a pipeline break at Athens, Georgia, spilled an unquantified amount of diesel fuel into a tributary to the Oconee River. The break took place on Friday and EPA was notified Sunday by the City Engineer at Athens after he was forced to close the entire city water system for twenty-four hours. Some sixty-four (64) complaints of oil sheens, taste and odors in the homes of residents, had been recorded. EPA immediately responded to the scene and found that the "spilling" company had placed two inch by four inch boards across the river and had constructed two simple under-flow dikes close to the spill site. It was initially noted that the water supply intake was eight feet beneath the surface and, while the river was running at approximately one knot, mechanical minipulation appeared to be minor. Also, no vortex was visible at the intake.

Even though the spill site was several miles from the water intake, it was immediately determined that something had to be done closer to the large quantity of the oil – which was still contained upstream in a swamp – to prevent it from continuing to leach as a surface-slick past the water intake. In this particular case, the decision was made to build wire fences at several points across the stream. In addition, some rule-of-thumb criteria were developed as to how thick and how far back upstream from the fence the straw should be placed in order to effectively prevent even a sheen from being released. At one knot – with this particular product – the "duck" of the oil beneath any surface obstacle, including the improvised booms, seemed to be eight feet.

Accordingly, straw was backed (six inches thick) ten to 15 feet upstream. The sheen was minimized to the point that it was hardly visible. These straw dams were replaced with fresh straw at six hour intervals. At this time, a tremendous fall-off of the taste and odor problem at the treatment plant was noted. Also, the activated carbon in the flash mixer was increased from one to four milligrams per liter and the constant rate of chlorination that was being used to treat the water prior to the spill was continued.

Basically, what was learned here was that the lighter cut fuels will duck a boom with some seemingly linear expression related to temperature, velocity, viscosity, and wind speed. Also, part of the chemical configuration of the product will penetrate into the water column, without heavy manipulation. It is possible – through an intensified and economic containment effort – to protect a water system from river spills.

Some questions also arose: – What fractions will reflect this penetrating characteristic? What happens to "batched" water that is super-chlorinated when it contains a hydrocarbon fraction?

Shepherdsville, Kentucky

In the summer of 1972 at Shepherdsville, Kentucky, another pipeline break resulted in a company losing some ten thousand gallons of *crude oil.* Initially, the spill showed up as a shortage at the receiving end of the pipeline. Aerial surveillance revealed no oil in any of the creeks or in the fields along the pipeline right-of-way. People were dispatched by the company to walk the pipeline and at that particular time a light sheen of oil and a very unusual looking stream was noted in the vicinity of Shepherdsville. EPA responded to the scene with company officials and began a search of what obviously was a rather large quantity of concealed crude oil.

The Figures reflect the characteristics of terrain and give some indication of the initial mystery surrounding the whereabouts of such a large quantity of oil. It can be noted that the stream with a bed, 16 to 20 feet wide, was in fact intermittent. (Figure 2). There seemed to be a small flow in the bed but the stream itself would submerge every one hundred feet or so and re-surface. Whatever minor quantity of oil had gotten into the stream initially seemed to have filtered up and out of the rock and sandy bed of the stream.

Most pipeline people will react to the possibility that the oil will take the hydraulic gradient characteristics of the pipe trench itself and generally be confined in the pipe trench to some point where it may surface because of pressures. In this particular case, it was obvious that the oil did not stay in the pipeline trench since the trench crossed the stream. The pipe depth was only one to two feet beneath the stream bed and there was absolutely no sheen of oil in the vicinity of the trench crossing. There was a detectable quantity of oil leaching into the stream from the bank some several hundred feet downstream from the pipe crossing. An investigation of the surface slopes, general characteristics of the terrain, and side slope out-croppings, suggested that the oil was probably in a gravel blanket layer some several feet beneath the surface of the ground. (Figures 1 & 3). It was decided to dig an intercepting type trench one hundred feet long to try to locate the oil. The oil was located as the sketches show and a large portion of the oil was retrieved. (Figure 4).

One of the most significant facts that precipitated from this exercise was that the oil does not always stay in the pipe trench and that a lack of oil visibility on pipeline surveys does not always indicate the absence of a major leak or spill.

Columbia, South Carolina

In the spring of 1972 a vandalized storage tank adjacent to the Congaree River near Columbia, South Carolina,

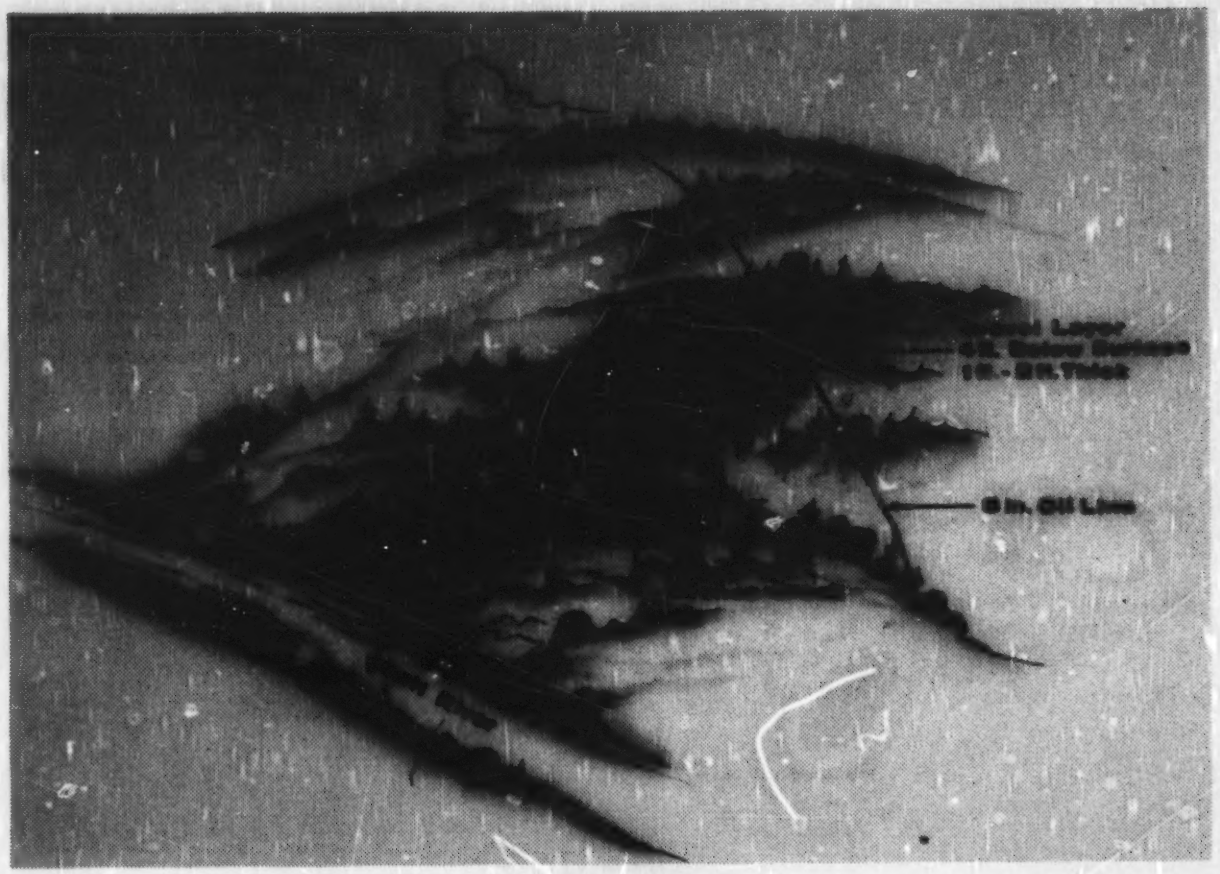

Figure 1: Topographic Features.

emptied approximately ten thousand gallons of *Bunker C fuel* into the Congaree main stem. EPA, along with South Carolina State officials and company officials, responded to the scene and established elaborate and sophisticated containment and recovery systems some thirty miles downstream of the spill. This particular long distance from the spill site was dictated because of absolute inaccessibility to the river bank itself. For several days – and at a considerable expense to the company – the arrival of the oil was awaited. Several reconnaissance missions upstream were performed daily and in each case the oil seemed to be in the stream moving very slowly downstream toward the containment and skimming booms. On the third day, however, a river reconnaissance revealed that there was absolutely no oil in the stream whatsoever. There were signs of oil stain for several miles on the adjacent vegetation cover of the river banks.

There is still considerable controversy as to the whereabouts of this ten thousand gallons of Bunker C oil. There are literature documentations of oil disappearing in turbulent waters. There are those involved with this particular spill who feel that the bank vegetation absorbed the oil. The writer feels that only some ten to twenty percent of the oil can be accounted for in this fashion; he is of the opinion that several meteorological parameters accounted for the balance of the disappearing oil. It was noted that the turbidity of the river was in the range of 1,000 to 1,200 parts per million, which is quite turbid. The wind speed of six to ten knots on the river surface was variable up and down stream. The velocity of the river seemed to be on the order of five to seven knots and the temperature approaching twenty degrees centigrade. All of these suggest a vulnerability to sinkage of the oil. The oil becoming entangled with the heavy turbidity, the manipulation by the wind, the turbulence and rotation characteristics of the velocity itself, and the low temperatures which reduced the viscosity of the oil itself, certainly are suggestive of sinking. This case went into our failure column.

Jackson, Mississippi

In the winter of 1972 at Jackson, Mississippi, a broken sludge pond dike at a drilling operation dumped 40,000 gallons of *oil slops and brine* into the Big Black River. Retention on the surface was impractical because of the eight to ten knot river velocity in the vicinity of the spills. Skimming equipment and containment type booms were evaluated as being impractical. There was an absence of available equipment in the Jackson vicinity (especially on a Friday night) and the river itself was almost inaccessible for some twenty to thirty miles downstream of the spills. The approach taken in this case by EPA and state officials, in the absence of any cooperation from the company that caused the spill, was to employ the use of light floating absorbing type booms. This particular boom is a relatively new con-

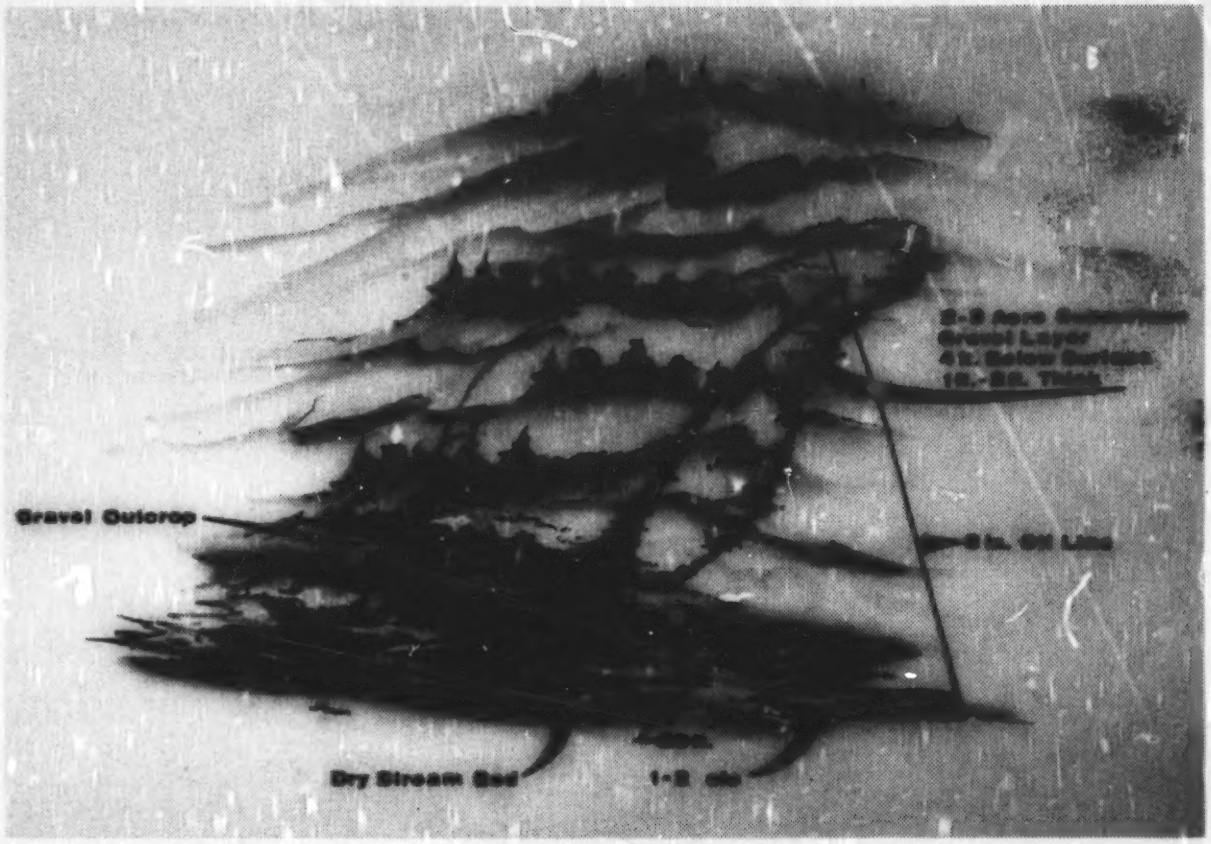

Figure 2: Spill Orientation.

cept in inland water oil spill control. At first glance at the make-up of this particular type boom, its weight, its general elevated profile on the water surface, would lead a casual observer to believe that it was a total waste of time and money. However, in this particular case, some twenty thousand gallons of the oil were actually recovered from the stream by using these disposable booms.

The cost to the Federal Government of recovering twenty thousand gallons of oil was $12,000; this subsequently reverted to the violator.

The products used in this particular recovery efforts are not new, but the approach is different. Light weight absorbents were actually rolled into onion sack type materials to form a boom some several hundred feet long that was supported with a one-half to one inch hemp rope. This was stretched across the stream and allowed to literally blot the oil from the surface. The booms were replaced as they filled with oil and then removed and buried. The final residual affect to environment of this spill was a loss of some twenty thousand gallons of oil to the stream, a large part of which was absorbed and is currently being weathered along some twenty miles of the stream bank and, of course, vegetation along the river bank absorbed a certain amount of this oil.

The valuable lesson here is not to allow the unavailability of sophisticated equipment to cease the clean-up effort. Field expedients are not only economic; they generally work.

Memphis, Tennessee

The final case study occurred at Memphis, Tennessee, in early 1972. Some 100,000 gallons of *Diesel fuel* was spilled from a storage facility into McKellar Lake on Nonconnah Creek near Memphis. Containment was readily available because other spills had occurred in the area and the company involved had the expertise to at least immobilize the oil. Recovery was something else. Actually, McKellar Lake is a large quiescent body of water located at the mouth of the stream in the vicinity of the spill site. The oil flowed directly into this short reach of stream and toward the large expansive lake surface. Some quantity of the oil escaped beyond the boomed area and meandered down the edge of the lake motivated principally by the wind, which of course will actually dominate a strong current. This is to say that a ten knot wind will certainly dominate a five knot current when the wind is directed or imposed upon the oil surface at a significant angle.

It was decided to try to contain this portion of oil by using one of the new "piston film" herders. In this particular case, the results were disastrously expensive. Our experience in this region with piston herders reflects that, generally, they are acceptable in quiescent waters where the thickness of the oil is limited and where the climatic parameters of wind and temperature are not dominating. In this case, there was a considerable amount of surface distortion in the form of trees, debris, etc., in the area adjacent to

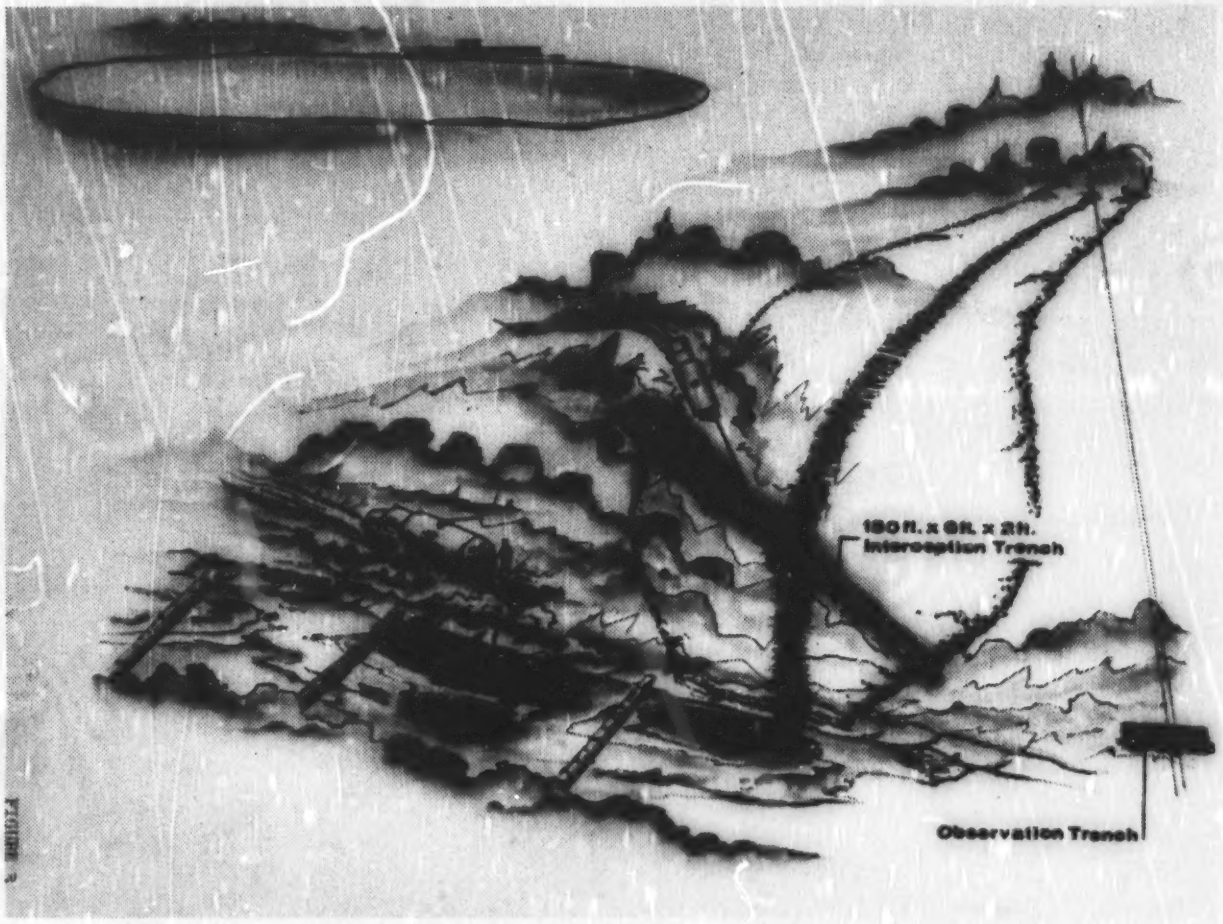

Figure 3: Recovery Schematic.

where the oil slick was moving. An attempt to try to place this herder around the periphery of the slick failed. In the open water area, the extremity of the boundary of the oil at its interface with the water was identifiable, but along the shore where the oil actually interfaced or ingrained itself within the shore line, it was impossible to apply the herder. The result was that the oil was driven from the principal open water area into the surface distorted area adjacent to the bank. Hundreds upon hundreds of small bushes and dead trees, floating logs, etc., were actually surrounded by a heavy concentration of the oil, making clean-up almost impossible. Essentially what happened is that each surface obstacle had formed around its exposure to the water surface a thick heavy ring of oil, which really shouldn't surprise anyone. To perform an effective clean-up, essentially everyone of these literally thousands of rings had to be cleaned up. The sum total of these rings now represented a sum total of the oil that originally was a slick some square mile on the surface area. In this particular case, the piston herder had no application. One must have command of the entire periphery of the oil slick and understand application techniques before attempting this method of clean-up. Indiscriminate use of these herders would be economic chaos. The concept to use herders is one that must be tempered with judgment and experience. No attempt should be made to use herders under docks or in any area where the velocity of the stream exceeds two to three knots and/or the surface wind exceeds three to four knots, and certainly not where there is any surface debris or fixed interruption. Control of the entire slick can be lost readily. This was the basic lesson that was learned in this particular incident.

There are other equally intriguing cases such as the loss of 120,000 gallons of Ethyl gasoline from a pipeline break near Nashville, Tennessee. Deep wells were drilled and long and deep observation trenches were dug over the entire area surrounding the spill and as far away as one mile. Until this day, only 20,000 gallons have been recovered with no trace of the other 100,000 gallons. The sump wells are pumped from time to time – so far, with negative results. There is the two billion gallon Phosphate Slime spill in Florida. This is considered a hazardous material spill since it "wiped out" seventy-five miles of the Peace River. The question is: How do you contain such a spill or how do you mitigate its damages?

Then there is the small six thousand gallon oil spill in Richardson Creek near Harris, North Carolina. This creek is a tributary to the Broad River, just upstream of the Cliffside Duke Power Company Plant. EPA officials coordinated the entire clean-up program, utilizing the Region's $3,000

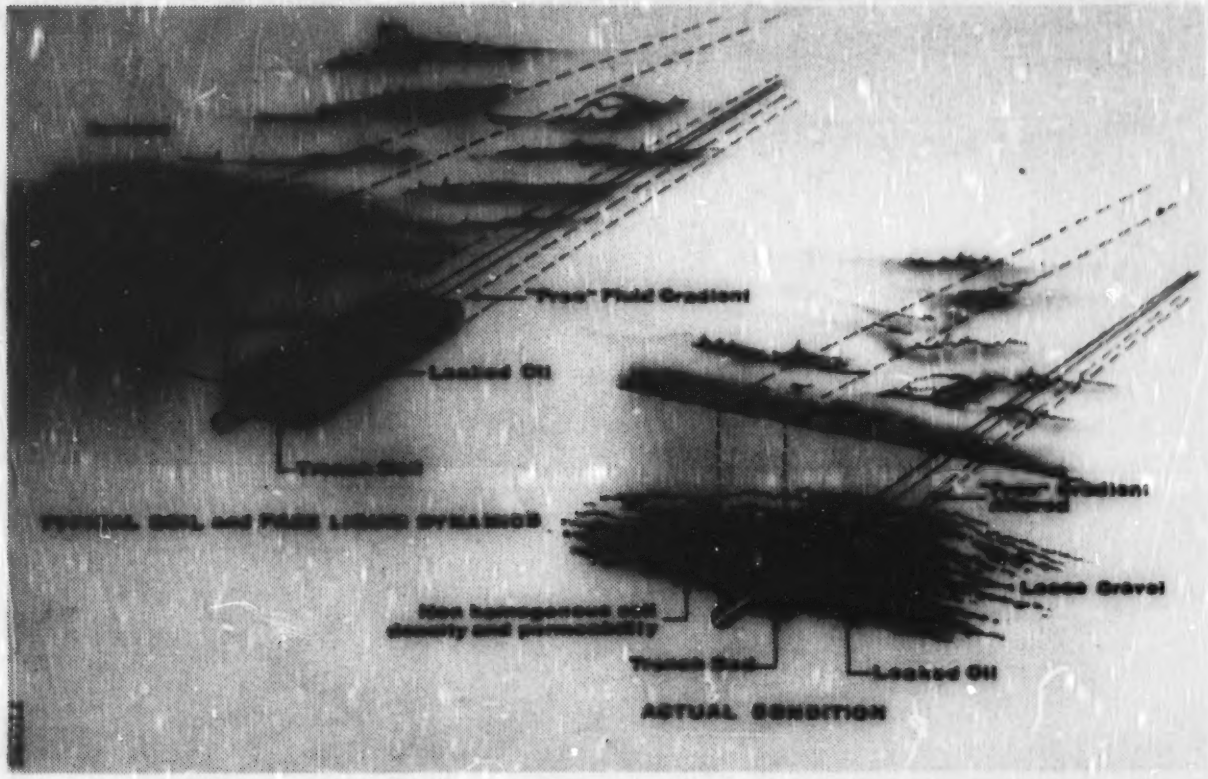

Figure 4: Subsurface Conditions.

emergency response vehicle and equipment. The August 22, 1972 edition of the Shelby, North Carolina, "Daily Star" quotes a North Carolina State Representative as follows: "One of the men from Duke Power told me that if the oil spill had not been found when it was, it would have cost Duke Power an estimated $800,000 a day. The plant would have had to close down." This reflects not on the Region but on the worth of concern for an inland oil spill program.

EPA, Region IV, in Atlanta has responded to over three hundred spills and spent close to one thousand man-days "on-scene" in the past three years and yet, the techniques used continue to be field expedients and the implements – farm tools. Containment and clean-up equipment is still largely designed for the Santa Barbaras or the Ocean Eagles – and that small portion that is appropriately designed for inland spills is so sparsely inventoried that it is generally ineffective.

But, considering all of the above, the most significant and glaring deficiency is the absolute void of information in "the Literature" concerned with damages to the inland water environment caused by oil spills. This author feels that the continuing uniqueness associated with inland spills directly correlates with the amplitude of national attention given this total problem in the past. We must stop talking of inland oil spill damage in terms of aesthetics; we must address the realistic problem of fish kills, extensive long-term biological damage and the denial of legitimate water uses. In fact, we must give parity to the inland program in terms of national attention. This means a shift in attitudes and understandings, research dollars and public information. Most elementary school students have heard of the Santa Barbara incident – how many graduate students have heard of the Harris, North Carolina, spill and the millions of dollars savings to one company?

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